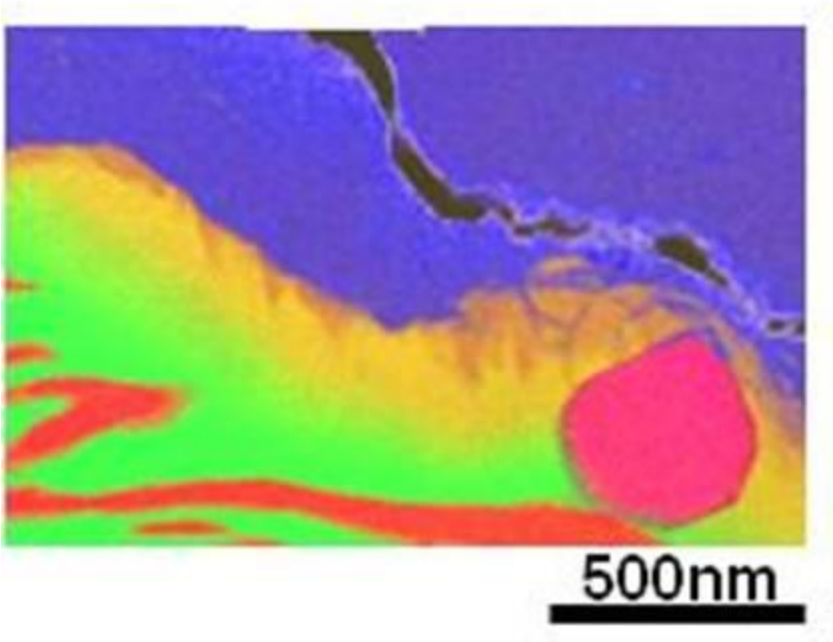
IOP Institute of Physics
Materials and Characterisation Group

NEWSLETTER **January 2017**

Issue no. 22



The complex nature of the metal / oxide interface during corrosion of Zircaloy clad materials, depicted using Electron Energy Loss Spectroscopy (EELS). Blue: ZrO_2, green: Zr, red: ZrH_y, orange: ZrO, yellow: $Zr(O)_{sat}$, pink: secondary phase particle (crack in the oxide has been coloured black) (Acknowledgement: Mhairi Gass, Amec Foster Wheeler)

Contents

Materials and Characterisation Group Committee	3
Chair's report	4
Materials used in Extreme and Hazardous Environments	5-7
Getting Chartered with the IOP	8
IOP Research Student Conference Fund Awards	9
Reports on Research Conferences supported by the Group	10-20
Recent and Forthcoming Conferences List	21
Contact Details for Group Officers and Group Website Links	22

Message from the Editor

Happy New Year! Welcome to the 2017 Institute of Physics Materials and Characterisation Group Newsletter. In this edition you'll find reports from the conferences we ran in the past year, a new section on the application of materials to extreme and hazardous environments and information about forthcoming conferences.

If there's anything you'd like to get involved with, or if you'd like to propose a new conference, the contact details for group officers can be found on the back page – please get in touch with any ideas or proposals!

Hello to IOP Materials readers, I am taking on the role of the group's newsletter editor for the next few issues. Firstly, I would like to thank Claire Dancer for supporting and supplying me information for the newsletter. A bit of background on myself, I am currently working as a consultant at Amec Foster Wheeler, Warrington which I have been for 3 and half years since I graduated from the University of Manchester in July 2013 with a MPhys (Hons) Physics degree. If you have any comments, or suggestions for content or features, please feel free to drop me a line at paul.binks@amecfw.com

Paul Binks, Newsletter Editor

This newsletter is also available on the web and in larger print sizes: see http://mc.iop.org

The Institute of Physics, 76 Portland Place, W1B 1NT, UK.
Tel: 020 7470 4800 Fax: 020 7470 4848

Materials and Characterisation Group Committee

Chair
Dr Richard Morris CPhys MInstP
Marie Curie Independent Fellow, IMEC, Belgium

Secretary
Dr Claire Dancer MInstP
Assistant Professor, University of Warwick, Warwick Manufacturing Group

Treasurer
Dr Sarah Fearn MInstP
Research Fellow, Imperial College London

Ordinary Members

Dr Giles Aldrich-Smith MInstP
AWE

Mr Paul Binks AMInstP
Consultant, Amec Foster Wheeler

Dr Graham Cooke CPhys MInstP
Senior Development Scientist, Hiden Analytical Ltd

Dr Alison Crossley MInstP
Manager of Oxford Characterisation Services, University of Oxford

Dr Jonathan Painter CPhys MInstP
Cranfield University

Dr Benjamin Robinson MInstP
Lecturer in Physics of Functional Materials, University of Lancaster

Dr Annela Seddon MInstP
Graduate Teaching & Research Fellow/Lecturer, University of Bristol

Chair's report

Dear M&C group member,

2016 was another productive year for the Materials and Characterization group as well as a year of transition.

In the case of transition, the group saw Jonathan Painter and Alison Crossley (Chair & Treasurer respectively) both standing down having completed their four year terms. I would like to thank them both for their time and effort as well as what they achieved in taking the group forward. Both have agreed to remain on the committee as ordinary members and their knowledge and advice will, I'm sure, be invaluable. We also said goodbye to a few ordinary members with Hari Reehal, Hamid Kheyrandish and Melvin Vopson all stepping down from the committee. Again I thank them for their time and important contributions. In October we welcomed a new treasurer and Chair, Sarah Fearn (treasurer) and Richard Morris (Chair), along with two ordinary members, Benjamin Robinson and Graham Cooke, onto the committee. I would like to highlight that we are still short of two members for a full committee so please get in touch if you have an interest.

Throughout 2016 the committee was actively supportive of numerous events focusing on materials and characterisation. This included group-led and co-sponsored events in addition to sponsored prizes for the best conference paper with some reports of these included in the following pages.

Moving forward and into 2017, our aim remains firmly focused on supporting our members in the best ways possible. We already have a number of excellent events lined up (group-led and co-sponsored) and are again supporting prizes at conferences, hence I strongly encourage you to keep an eye on the group calendar so as not to miss out on anything. The group also encourages and will continue to support applications from students and early career researchers eligible to apply for IOP bursaries which can assist in the financial aspect when attending research facilities to carry out experiments or international conferences to present their research.

For us to continue to evolve and improve our support for you, the take home message has to be, the more feedback and interaction we receive from you, the better this will work. I therefore encourage you to engage with the committee and the IOP.

I would like to conclude by wishing you all a successful 2017.

Best regards,
Richard Morris

Materials used in Extreme and Hazardous Environments

Neutron Damage Effects on Pressurised Water Reactor (PWR) core cladding

Report: Paul Binks, Amec Foster Wheeler

To start off my first newsletter nice and simply, I will be reporting on something I know about. This is a new section in the group newsletter which will highlight current activities within the industry and academia focusing on materials that experience extreme and hazardous environments. It aims to bind together advanced materials research with industrial or commercial needs. The first report will focus on the effect of neutrons on materials present inside the reactor core of a Pressurized Water Reactor (PWR).

Neutron irradiation can have significant effects on the structure and performance of materials used in nuclear reactor cores. Neutrons produced by nuclear fission within the fuel (typically uranium oxide, UO_2) have sufficient kinetic energy to displace the atoms in the lattice of the core components from their original lattice positions and into an interstitial site leaving behind a vacancy. The interstitial and vacancy together are known as a Frenkel pair and over a reactor lifecycle, the Frenkel pairs can build up to form large defects which lead to deformation or weakening in the structure of the material and therefore the reactor. Understanding this phenomenon is important to ensure safe reactor operation and to support the long-life safety justification of a reactor core.

Western PWRs use enriched uranium in the form of UO_2 pellets as the fuel which is contained within a tube of metallic alloy cladding; the cladding is used as structural support for the core, confinement of the fuel and fission products and to allow good heat transfer between the coolant and the fuel. The cladding is usually a member of the zirconium alloy (e.g. Zircaloy) family due to the low thermal neutron absorption cross section and good corrosion resistance of these alloys. In the case of a PWR, the neutron moderator and reactor coolant is generally light water (H_2O).

The primary circuit loop in a PWR typically operates at temperatures between 280°C to 320 °C. The water is maintained under a pressure of ~15 MPa so that the water does not boil. Typically PWRs have fast neutron flux ranging from 10^{13} to 10^{14} n $cm^{-2}s^{-1}$. As a results of increasing electricity demands, PWRs are expected to reach fuel burnup up to ~40 GWd/tU. Zirconium alloy cladding will typically experience 20 displacements per atom (dpa) per ~40 GWd/tU on average by neutrons. This means an atom (e.g. Zr) in the metallic lattice structure will be displaced from its original position 20 times, this causes damage in the

material. A number of defects are caused by neutrons e.g. voids, vacancies and dislocations and microstructural characterisation and defect simulation are particular areas of interest within the ongoing research in this field.

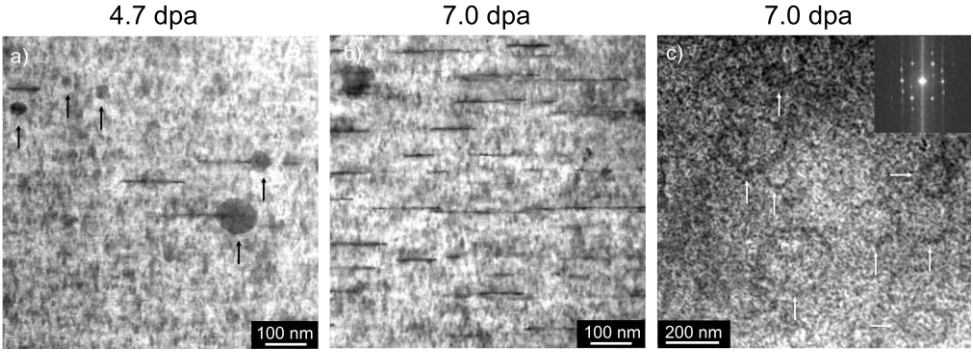
The neutron radiation-induced damage in material is a result of the accumulation of microstructural defects. An average fission neutron has kinetic energy of 2 MeV and the typical threshold energy to displace an atom from its lattice is between 20 to 40 eV. This results in ~50 000 atoms being displaced from their original lattice position in a displacement cascade. For most metals roughly 90 to 99 % of the displaced atoms recombine with a vacancy within the metal matrix with the aid of elevated temperatures; this is known as thermal recovery and zirconium alloys are generally considered to have very good thermal recovery after irradiation damage. The remaining vacancy sites and re-arrangement of atoms caused by radiation damage disrupts the material on the micro-scale which can later affect the macro-scale.

The current neutron irradiation-induced challenges to a PWR core include irradiation growth, irradiation creep and enhanced corrosion.

- Irradiation-induced growth leads to dimensional changes in different directions dependant on the material's metallography.
- Irradiation creep is deformation caused by radiation-induction defects depending on the orientation of defects relative to an applied stress. Once the applied stress is removed, the material does not return to its original dimensions.
- Zirconium alloys are known to suffer enhanced corrosion in-reactor relative to out-of-reactor. The radiation-induced effects are still not well understood. Secondary Phase Particles (such as those found in the Zircaloy family) become amorphous under neutron irradiation and neutrons may be responsible for the evolution of fine equiaxed grains which may influence the enhanced corrosion. The poor corrosion performance leads to reduce heat transfer which can in turn affect plant performance. In addition oxide deposits may enter the coolant which will increase the reactor's radioactivity.

To develop irradiation understanding, the use of a commercial nuclear reactor is costly and its takes a long time for the damage to accumulate. Accelerated test reactors, which tend to operate at specific conditions so that realistic damage can be produced at faster rate are also expensive to use. The less expensive and faster damage rate alternative is to use ion beams, were ions e.g. protons and helium are accelerated, which in turn collide with the material of interest at the end of the beam line.

One major difference between neutrons and ions is that ions only penetrate a short distance into a material compared to neutrons which travel further and damage the material throughout. This means that ion implantation experiments only create damage up to a particular depth in a sample. A Stopping and Range of Ions in Matter (SRIM) calculation highlights that most of the ion's energy is dumped at a particular penetration depth where the highest damage level is expected to be found. An example of damage caused by proton irradiation can be found in the figure below.



Evolution of c-loop dislocations formed in Zircaloy-2. Provided by Professor Michael Preuss and Dr Allan Harte (University of Manchester).

The next generation of nuclear reactors are expected to operate at higher fuel burnup levels than their predecessors and will, therefore, experience an increased radiation field. Employing ion beams to simulate neutron damage is useful to develop an understanding of the mechanisms involved, but it is important that these data are validated against neutron irradiated material. Therefore, studying both neutron and ion irradiated material is important in order to develop the required knowledge for reactor core design and operation for the next generation of nuclear reactors.

Getting Chartered with the IOP

One of the many reasons why you may be a member of the IOP is the opportunity to gain professional designations by becoming a chartered Physicist (CPhys) or Engineer (CEng).

CPhys can only be gained through the IOP and is awarded to those who work in a physics-related scientific field. In addition to the completed application form, you must submit:

- Details of your two supporters (one of whom must be a Chartered Physicist) and a covering letter explaining the choice of supporters, if they are not IOP members.
- Current CV
- Notarised copies of your Degree certificates
- Organisational chart
- Professional review report

If you do not hold a Masters degree in Physics, but work in a clearly physics-related sector, you can still apply for CPhys although some extra documents are required:

- For those who hold an accredited Bachelor's degree in Physics (but not an accredited Masters) you will need to complete the Master's project equivalence report.
- If your degree is not accredited by the IOP, in addition to the Master's project equivalence report you must also complete the "Core of Physics" section of the application form, which confirms that you have a baseline level of physics knowledge achieved through your education and professional experience.

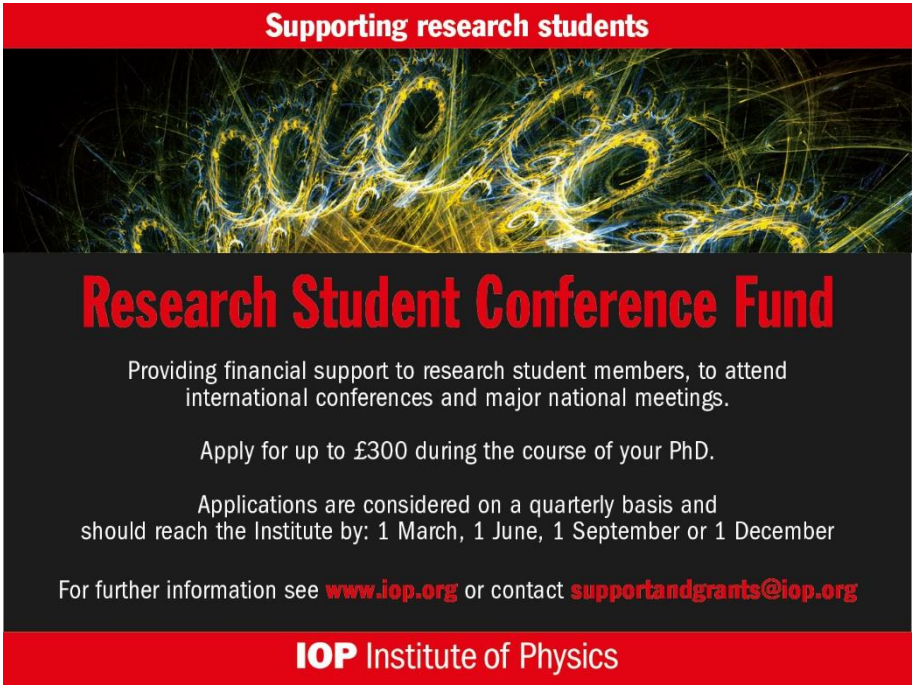
CEng is however awarded by a number of bodies including the IOP and recognises experience in the engineering-related sectors. Similar documents are required for CEng as for CPhys although the focus in this case should be on your experience in an engineering-related sector and your supporters must be chartered engineers. If you do not hold an accredited MEng degree, a technical report is required.

Once your application has been reviewed you will be asked to attend an interview, and you should receive the result of your application within 4 weeks of your interview.

For more information please visit the IOP page and for attending 'Getting Chartered' workshops:http://www.iop.org/membership/prof-dev/tools/workshops/page_38316.html or email cpd@iop.org

IOP Research Student Conference Fund

Student members can obtain funding from the IOP Materials and Characterisation Group to attend a meeting or conference. Each year we have several Research Student Conference Fund bursaries worth up to £300 to give away. The eligibility criteria and application form are available at http://www.iop.org/about/grants/



As part of being awarded a bursary you must write a short report on your experience at the conference. Selected reports will then be published in this group newsletter.

On the next page you will find a report from a recent Research Student Conference Fund awardee.

Reports on Conferences Supported by the Group

12th Photovoltaics Science, Applications & Technology Conference (PVSAT-12) University of Liverpool, 6-8 April 2016

Report: Dr Nigel B Mason, Conference Chair

Liverpool did us proud! For some years now, PVSAT has claimed to be the UK's premier scientific conference on solar PV and I feel we have again justified this claim on the occasion of PVSAT-12, our 12th annual event. As initiated at last year's event in Leeds, we again held a Postdoctoral Training Workshop on the day preceding the conference so that student delegates could attend both events and keep costs down. This year for the first time PVSAT hosted a small workshop for the EU-funded project Steel PV to disseminate its work exploring the fabrication of PV cells on steel sheet for building integrated applications.

First the stats. This year 110 delegates listened to 8 presentations by invited international guest speakers, 32 contributory speakers and 37 poster presentations. Perovskite PV cells narrowly beat CdTe with 12 papers having the former in their title compared to 11 for the latter. Presentations on other PV semiconductor materials included CZTS (5 papers), CIGS (4), OPV (4), quantum dots (3), dye-sensitised (2), c-Si (2) and others (8).

Amongst many scientific highlights at the conference was a presentation by Prof Jan Schmidt (ISFH, Germany) on the potential of novel heterojunction solar cells including the possibility of 37% efficient tandem cells of perovskite on silicon. Quantum ring solar cells with efficiency of 11.4% were reported by Peter Carrington (Lancaster) and single-walled carbon nanotube/PbS quantum dot cells with 6.5% efficiency reported by Yujiro Tazawa (Oxford).

Other keynote presentations included; PV integration into low-voltage distribution networks (Keith Sunderland, DIT Ireland), a new energy yield performance standard for PV modules (Markus Schweiger, TŰV, Germany), thin film PV for building integration (Yulia Galagan, TNO Host, The Netherlands) and life cycle assessment of PV (Mariska de Wild-Scholten, SmartGreenScans, The Netherlands). Two excellent presentations were given in the field of CdTe thin film cells by Prof Ken Durose (Liverpool) and Dr Wyatt Metzger (NREL, USA) who covered historic and current challenges with this technology.

Dan Lamb (Glyndŵr University) reported progress on a project to evaluate CdTe thin film cells in space satellites. Space cells are typically multi-junction devices based on III/V semiconductors but CdTe thin film PV offers exceptional high performance-to-weight ratio demanded for space application. The first flight test

of these “made in Wales” cells is due for launch on 29 July 2016. We wish them a successful mission.

Whilst PVSAT has a predominantly science outlook, it is always helpful to view this in a commercial context and Dr Finlay Colville (Solar Media) gave an invited talk on market perspectives and insight into the challenge of the barrier-to-entry of new non-silicon PV cells in a market dominated by crystalline silicon technology.

The conference dinner was held in The Athenaeum, founded in 1797 to provide a meeting place where ideas and information could be exchanged. Today it is located in an elegant building erected in 1928 in the centre of Liverpool. Here we were entertained by live music performed by Liverpool Jazz and an amusing talk of his experiences with electric cars and the promotion of renewable energy by Robert Llewellyn (aka Kryten in Red Dwarf and host of Scrapheap Challenge).

Conference exhibitors included IET Journals, Newport, Kurt J Lesker and LOT Quantum Design.

PVSAT-12 is, as always, very grateful to our sponsors for supporting the event and helping to keep the student fee for conference attendance to a minimum. This year’s sponsors included; IET Journals, Royal Society of Chemistry: Energy Sector Group, Supergen SuperSolar, SHARP, University of Liverpool, Steel PV and the Institute of Physics: Materials and Characterisation Group.

Student best paper prize (sponsored by the IOP Materials and Characterisation Group)

Husyira Al Husna Binti-Mohd-Nasim of Loughborough University, “Validation of Spectral Response Polychromatic Method Measurement of Full Size Photovoltaic Modules using Outdoor Measured Data” by H. Alhusna, A. Smith, T.R. Betts, R. Gottschalg.

Best poster prize

S Mariotti, L Phillips and K Durose of the University of Liverpool, “Investigation of the stability of methylammonium lead iodide layers”.

Best paper prize

D. A. Lamb, S. J. C. Irvine, M. C. I. Underwood, A. Baker, J. Hall R.Kimber of Glyndwr University, “Preparation of CdTe PV on Ultra-thin Space Cover Glass for flight testing on the AlSat-Nano Satellite Mission”.

PVSAT-13 will be held at The University of Bangor, N Wales, 5-7 April 2017. www.pvsat.org.uk

Delegates applauding the paper and poster prize winners at dinner in The Athenaeum, Liverpool.

PVSAT-12 delegates outside the conference venue on the last day

2nd International Workshop on the Applications of Novel Scintillators in Research and Industry

University College Dublin, Dublin, 11-13 May 2016

Report: Jonathan Painter (University of Cranfield)

A three day workshop on the development of novel inorganic and organic scintillators for various applications in research and industry, was hosted for the second year running at University College Dublin, from the 11th-13th of May, 2016.

The event was sponsored by the Institute of Physics' Nuclear Physics, Nuclear Industry, Instrument Science and Technology and Materials and Characterisation groups, as well as Science Foundation Ireland, ORTEC/Ametek, Scionix, Failte Ireland and UCD. The agenda, workshop photo, and most of the presentations can be found on the ANSRI workshop website here. The speakers included representatitves from many industries, research laboratories and academic institutions worldwide. The content of the packed, three day program included; the development and characterisation of novel scintillators (such as ceramics, plastic and inorganic halide scintillators), and the applications of such scintillators in a wide range of fields. Such application areas include; nuclear physics, medicine, gamma-ray astronomy, geophysics, and security.

Early career prizes sponsored by ORTEC/Ametek, were judged by professionals in the field of scintillator research during the workshop. The first place prize was awarded to Ms. Shuping Liu, a PhD student from the Shanghai Institute of Ceramics at the Chinese Academy of Sciences, for her talk entitled “Composition dependence of luminescence and scintillation properties of LuAg:Ce,Mg optical ceramics”. Two runner-up prizes were also awarded to outstanding oral and poster contributions from Ms. Alice Mentana (INFN-Milan) and Oleksii Poleshchuk (KU Leuven). The event was attended by around 60 people from many different industries and scientific communities located in 14 countries, and was successful in its primary goal of uniting and re-uniting many different scientists and industries together in relevant areas to collaborate on similar future projects in the field of scintillator research. The feedback received for this small international workshop for the second year running was positive, and it is likely that the exchanges between workshop attendees, will lead to many fruitful scientific endeavours in the years to come.

ANSRI workshop delegates

Nanoparticle Characterisation - Challenges for the Community
IOP Portland Place, London, 4 July 2016

Report: Alison Crossley (University of Oxford)

Nanoparticle Characterisation - Challenges for the Community was a one day meeting held on Monday 4th July 2016 at the IOP Portland Place, London. This event was organised by the Materials and Characterisation Group and sponsored by the Thin Films Group, BBI Solutions, Analytic and Blue Scientific.

The first speaker was Professor Richard Palmer, University of Birmingham who discussed the Scale-Up and Atomic-Scale Imaging of Size-Selected Reference Nanoparticles. Size-selected nanoclusters, deposited from the beam, represent attractive reference particles for nanometrology, as well as functional nanomaterials in their own right, with applications in catalysis, theranostics and photonics, etc. He discussed the generation and size-control of such nanoclusters, and in particular efforts to scale-up the rate of production towards the gram scale via the Matrix Assembly Cluster Source (MACS) where the clusters are produced in vacuum by ion beam sputtering of a cryogenic matrix doped with the metal atoms of choice; the degree of doping determines the cluster size to a precision of about 10% in diameter, narrow by the standards of catalysts. Aberration-corrected STEM was used in dark field mode to elucidate the atomic structures of size-selected metal clusters; these studies shed light on kinetic trapping (metastability) of the nanoparticle structures and the response of the nanoclusters to realistic application conditions. Taken together, the abundant generation of size-controlled clusters and the imaging of their atomic structures in the STEM appeared to present a new platform for nanometrology of advanced functional materials.

Kelly Warner from BBI Solutions UK then presented the industrial scientists point of view of characterising nanoparticles and nanoparticle products with requirements driven by both customer and business. Kelly stressed the importance to the business of ensuring quality of product and robustness of process, in addition to meeting regulatory requirements.

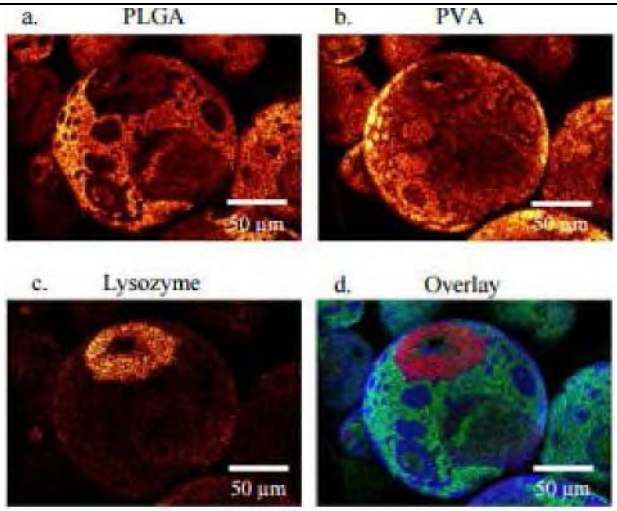
The plenary talk entitled “Measuring nanoparticle properties: are we high and dry or all at sea?” was given by Caterina Minelli of the National Physical Laboratory, UK.

Caterina stressed the importance of having reliable and reproducible measurement methods for nanoparticles to facilitate the uptake of these materials in commercial applications and allow industry to comply with regulation. The challenges in the analysis of nanomaterials were described as being due to, among other factors, the interdisciplinary nature of the field, the lack of adequate

reference materials to calibrate analytical tools and the difficulties associated both with sample preparation for analysis and the interpretation of data. The preparation of nanoparticle samples for analysis was shown to significantly alter both the nanoparticles themselves and the results of the analysis. In order to produce relevant and meaningful data from nanoparticle analysis it is therefore important to establish sound sample preparation protocols. Combining techniques which can be employed directly to colloidal suspensions and on the dried particles were shown to be vital for meaningful interpretation. Examples discussed included the measurement of the density of polymeric nanoparticles by Small Angle X-ray Scattering (SAXS) and analytical centrifugation, and the analysis of the protein coatings on gold nanoparticles in liquid media (in-situ) and ex-situ with high vacuum techniques such as X-ray Photoelectron Spectroscopy (XPS) and Low Energy Ion Scattering (LEIS). Inter-laboratory studies enabled the refinement of sample preparation protocols and data analysis, which in turn have a positive impact on the broader adoption of the analytical method for nanoparticle characterisation. The main outcomes of a VAMAS inter-laboratory study whose aims included to assess the inter-laboratory variability in the measurement of nanoparticle coatings using XPS and LEIS were being used to input into ongoing efforts in ISO TC201 to standardize the surface chemical analysis of nanoparticles. Finally, unmet challenges in the characterisation of nanoparticles were discussed. For example, the measurement of nanoparticles' concentration and the in-situ analysis of nanomaterials in complex matrices which are highly sought after by industry and regulatory bodies.

The final talk of the morning was on Challenges and Opportunities in Nanoparticle Analysis using Time-of-Flight Secondary Ion Mass Spectroscopy (ToF-SIMS). This was given by David Scurr from the University of Nottingham. UK.

The ToF-SIMS technique which possesses high chemical sensitivity, high surface sensitivity (with the upper 2 - 3 nm probed) and molecular specificity and in addition has the capability to chemically map the surface of a given sample was shown to be important in particulate systems as well as other many areas of research. One example shown was the analysis of drug delivery using micro and nanoparticles. An example of a drug loaded micro particle is show in the figure below which illustrates the distribution of a variety of chemistries upon a micro particle delivery system. The opportunities in this field were discussed along with the challenges and limitations which must be acknowledged and addressed for the successful application of the technique to systems of this scale.



ToF-SIMS imaging of the surface of a microsphere showing the secondary ion image generated from the diagnostic anions identified within the ToF-SIMS spectra, for a) PLGA (m/z 71/73 and 87/89), b) PVA (m/z 59), c) lysozyme (m/z 26 and 42) and d) an overlay showing PLGA (green), PVA (blue) and lysozyme (red).'

Lunch provided an opportunity for the attending 54 delegates to network and view the posters on display as well as talk to the industrial and equipment sponsors.

After lunch Robert Hamiman from the University of Bristol presented a talk on Innovation in nano-scale characterization: Mapping a femto-Newton force regime with vertical cantilever microscopy.

Robert showed how, since its invention in 1986 the field of Atomic Force Microscopy (AFM) has been constantly evolving with refinements and adaptations to the original designs allowing the investigation of a wide variety of sample properties, from surface potential to molecular binding forces, with resolution even reaching the sub-atomic level. At the University of Bristol they have developed a unique evolutionary step in the story of AFM in the form of Vertical Cantilever Microscopy (VCM). This technique harnesses vertically oriented probes combining them with a scattered evanescent wave detection system to provide a unique combination of sub-nanometre control of the interacting tip and femto-newton force sensitivity. After briefly presenting some of the more interesting samples characterised by various modes of AFM, the talk will focussed on the development and application of VCM. This ranged from the key modes of the technique which enable the characterisation of ultra-structure in delicate nanoparticles, through the latest results in high-speed VCM visualisation of the "birth of copper", this being the first stable nucleation sites of copper in electro-

deposition. Challenges which have been overcome in adapting VCM for the investigation of extremely weak optical forces, less than 1 pN in complex electromagnetic fields have confirmed the existence of an extraordinary momentum of light, perpendicular to its propagation direction. Thus a new tool to study light matter interactions on an unprecedented scale has been produced.

The formal part of the day was concluded by Professor Peter Dobson, University of Oxford, UK with a talk entitled Nanoparticles: What do we need to know and can we measure everything we need to.

Professor Dobson described how the application of nanotechnology is beginning to have an increasing acceptance and penetration into many sectors and with this there is the "need to know" about many of the finer details of nanoparticles. Electron microscopies and x-ray and electron diffraction will always be to the fore in characterisation methods, but we are a stage where we have to quantify much more than the shape and size of a select part of a sample. We can also measure size distributions, the degree of agglomeration, surface charge, surface area and to some extent, surface chemistry. As the scale of nanoparticle manufacture increases we will be asked to have rapid and reliable quantification techniques available for on-line monitoring in manufacture or in monitoring the waste and effluent from production units. Few such techniques are currently available. This talk attempted to identify the methods that are available now and challenged the participants to consider the instrumentation that needs to be developed to give the important information for manufacture and environmental regulatory purposes. It was stressed that while this will pose some challenges but also provide business opportunities.

An informal open discussion then followed facilitated by a panel of experts which include all the speakers and Professor Eugenia (Éva) Valsami-Jones, Director of the University of Birmingham's Facility for Environmental Nanoscience Analysis and Characterisation (FENAC) and Professor Barry Park an experienced consultant in nanomaterials technology including IP, regulatory affairs, toxicology, manufacturing.

The meeting concluded with Kelly Warner awarding the BBI Solutions sponsored price for the best poster to Natalie Belsey from NPL for a poster on A VAMAS inter-laboratory study of the measurement of chemistry and thickness of nanoparticle coatings, which the judges felt made a significant contribution the challenges emphasized during this vibrant meeting. Delegates departed with enthusiastic requests directed to the organisers for a follow up meeting in the future.

This year the American Vacuum Society held its 61st meeting in Baltimore. This was the first year that a focus topic on the Conservation Science of Heritage

Materials had been held at this meeting and the three half-day sessions were well attended, with only standing room available at times. The meeting had a good mix of scientific talks and case studies from conservators. The focus topic has had a large impact and articles have appeared as a result, including a piece in Inside Science: http://www.insidescience.org/content/science-and-art-meet-unveiling-mystery-and-cultural-tragedy/2316. A future focus topic session is planned for AVS 63 in 2016; this will be held at a similar time of year in Nashville, US.

Christmas Evening Networking and Outreach Event
IOP Portland Place, London, 20th December 2016

Report: Alison Crossley (University of Oxford)

Materials and Characterisation Group rounded off 2016 by holding an inaugural Christmas Evening Networking and Outreach Event on 20th December 2016 at the IOP, Portland Place, London.

Over 30 attendees enjoyed mingling over festive mince pies and mulled wine. They were treated to an animated lecture on the achievements of the pupils of the Young Engineers Club at The Joseph Whitaker School in Nottinghamshire and their rocket cars. The lecture and demonstration was given by the inspirational teacher and founder of the Young Engineers Club, Phil Worsley, a teacher and specialist in Electronics, Systems and Control for pupils aged 11 - 19. Phil has run successful STEM clubs throughout his teaching career and has won many local, regional and National STEM competitions. Phil has promoted gender equality in his teaching to ensure that all activities are by their nature non-gender specific, removing the 'barrier' of why girls shouldn't do science and engineering. Phil's Young Engineers team are 1/3rd girls and they are no different in their perception of STEM. They all find this way of learning exciting!

Phil told us the story of a teacher, some amazing school children and a Guinness World record attempt for the fastest model rocket car that started in Birmingham at 96 miles per hour in 2013. And how they, one year later reached 533.1 mph on a wet October morning in 2014. Two years later, on the 26th June 2017 at Santa Pod Raceway, Wellingborough, Northamptonshire they are going for the Sound Barrier (which they might have already almost broken at 730 miles per hour). Phil Worsley and his intrepid team are wanting to go faster, much faster! The lecture featured video and sounds of launches, whooshes and crashes and explained how they have overcome so many issues to consider breaking the Sound Barrier, including Phil obtaining a certification of competency which permits individuals to purchase and use **rocket** motors. You can find out more information about Phil in this BBC News video.

Recent and Forthcoming Conferences supported by the IOP Materials and Characterisation Group

2017

13th Photovoltaic Science, Application and Technology Conference (PVSAT) 2017
University of Bangor, 7th-9th April 2017
http://www.pvsat.org.uk

Characterisation of Materials used in Nuclear Environments
Institute of Physics HQ, London, 4th July 2017
https://www.iopconferences.org/iop/1032/home

Nanoanalysis of Steels and Structural Alloys
Organised by the IOP Electron Microscopy and Analysis group
Buchanan Arms Hotel, Dryman Stirlingshire, 7th-8th September 2017
http://nssa2017.iopconfs.org/home

Reports on these meetings will be published in the next edition of the newsletter.

Updated information about conferences will be added to the group website http://mc.iop.org when available.

MC Group Contact Information

Group Officers Contact Details

Chair
Dr Richard Morris CPhys MInstP
Marie Curie Independent Fellow
IMEC, Belgium
Tel: +32 16 28 17 58
Email: Richard.Morris@imec.be

Secretary
Dr Claire Dancer MInstP
Assistant Professor
University of Warwick, International Institute for Nanocomposite Manufacturing, Warwick Manufacturing Group, Coventry, CV4 7AL
Tel: (02476) 573259
Email: c.dancer@warwick.ac.uk

Treasurer
Dr Sarah Fearn MInstP
Senior Lecturer
Imperial College London, Department of Materials, Imperial College, London, SW7 2BP
Tel: +44(0) 207 594 6740
Email: s.fearn@imperial.ac.uk

Group Web Links

IOP Website

Our Group website address http://mc.iop.org is where you will find up to date information on the activities of the group including registration details for the conferences we sponsor and organise.

Materials and Characterisation Group Blog

We also have a Materials and Characterisation Group Blog which can be found at http://materials-characterisation-group-iop.blogspot.co.uk/ If you are interested in contributing to the Group Blog please contact the group.